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DEPARTMENT OF THE ARMY
HEADQUARTERS FORT DEVENS
FORT DEVENS, MASSACHUSETTS

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REPLY TO
ATTENTION OF:

Environmental Management Office

SUBJECT: Geohydrologic Study No. 38-26-KL45-93 U.S. Army Reserve Center-Chester, Vermont 26-29 April 1993

Mr. Robert B. Finucane
Vermont Department of Environmental Conservation
Hazardous Materials Management Division
Site Management Section
103 South Main Street/West Building
Waterbury, Vermont 05671-0404

Dear Mr. Finucane:

References:

a. Memorandum, Vermont Department of Environmental Conservation, Site Management Section, January 14, 1993, subject: Site Investigation Report for the U.S. Army Reserve Center in Chester, Vermont (Site #92-1287).

b. Memorandum, Headquarters Fort Devens, Environmental Management Office, March 1, 1993, subject: Site Investigation Report, U.S. Army Reserve Center Chester, Vermont (Vermont Site #92-1287).

The U.S. Army Environmental Hygiene Agency has completed the enclosed supplemental Geohydrological Study as requested in reference a.

The report concludes that the site does not contain levels of contamination that present a risk or hazard to human health or the environment.

Based on this recommendation we plan no further action at this site.

If you have questions or comments regarding this report please contact Mr. Joseph Pierce, Chief, Installation Restoration Division at (508) 796-3846.

Sincerely,

Edward P. Nuttall
Colonel, U.S. Army
Commanding

Enclosure

Copies Furnished:

76th Division, LTC Diehl (w/enclosure)
94th ARCOM, Mr. Puryear (w/enclosure)
USARC Chester, Vermont, Mr. Gonyea (w/enclosure)

USAEHA

U.S. Army Environmental Hygiene Agency

GEOHYDROLOGIC STUDY NO. 38-26-KL45-93
U.S. ARMY RESERVE CENTER-CHESTER
CHESTER, VERMONT
26-29 APRIL 1993

Nationally Recognized as the Center of Matrixed Occupational and Environmental Health Excellence

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

EXECUTIVE SUMMARY
GEOHYDROLOGIC STUDY NO. 38-26-KL45-93
U.S. ARMY RESERVE CENTER-CHESTER
CHESTER, VERMONT
26-29 APRIL 1993

1. PURPOSE. The purpose of this geohydrologic study was to install three additional ground-water monitoring wells, collect soil samples from these wells, and ground-water samples from these three wells and the six existing wells. This study will identify the presence or absence of any release of fuel oil constituents which may be hazardous to human health and the environment from two previously leaking underground storage tanks (USTs) and/or their associated pipelines.

2. CONCLUSIONS.

a. Three additional ground-water monitoring wells were installed at the Chester Memorial U.S. Army Reserve Center. Ground water flows toward the southeast.

b. The chemical analyses from the ground-water and soil samples confirmed that a release of fuel oil had occurred from the leak at the 4,000-gallon UST and from a spill of fuel oil within the boiler room.

c. Neither the volatile nor semivolatile organic compounds detected in the ground-water exceeded the National Primary Drinking Water Regulation.

d. Both USTs have been removed by a private contractor, and the bulk of the contaminated soil surrounding these USTs has also been removed. Therefore, the source of the fuel oil leaks no longer exists. The soil and ground water near one of these USTs indicate that a leak had occurred; however, the contamination is relatively small, has been undergoing weathering, and poses no hazard to human health or to the environment.

3. RECOMMENDATION. Coordinate the data and interpretations presented in this report with the Sites Management Section, Hazardous Materials Management Division of the State of Vermont's Department of Environmental Conservation.

CONTENTS

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-ME-SG

GEOHYDROLOGIC STUDY NO. 38-26-KL45-93
U.S. ARMY RESERVE CENTER-CHESTER
CHESTER, VERMONT
26-29 APRIL 1993

I. REFERENCES. See Appendix A for a list of references.

II. AUTHORITY.

A. AEHA Form 250-R, FORSCOM, 5 March 1993.

B. Memorandum, USAEHA, HSHB-ZA, 18 March 1993, subject: USAEHA Schedule of Field Services, FY 93.

C. Memorandum, FORSCOM, FCEN-CED-E, 10 March 1993 (AFZD-EM/23 Feb 93), 1st End, subject: U.S. Army Environmental Hygiene Agency (AEHA) Mission Services to Fort Devens.

III. PURPOSE. The purpose of this geohydrologic study was to install three additional ground-water monitoring wells, collect soil samples from these wells, and ground-water samples from these three wells and the six existing wells. This study will identify the presence or absence of any release of fuel oil constituents which may be hazardous to human health and the environment from two previously leaking underground storage tanks (USTs) and/or their associated pipelines.

IV. GENERAL.

A. Personnel Contacted.

1. Mr. William Gonyea, Building Technician, Chester Memorial U.S. Army Reserve Center (USARC), Chester, Vermont.

Use of company names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

2. Mr. Greg Cravedi, Environmental Protection Specialist, Installation Restoration Division, DEH Environmental Management Office, Fort Devens, Massachusetts.

3. Mr. Joseph Pierce, Chief, Installation Restoration Division, DEH Environmental Management Office, Fort Devens, Massachusetts.

B. U.S. Army Environmental Hygiene Agency Personnel Conducting the Study. The following personnel conducted the installation of ground-water monitoring wells and the ground-water sampling:

1. Mr. David C. Bayha, Hydrologist, Project Manager, U.S. Army Environmental Hygiene Agency (USAEHA), Waste Disposal Engineering Division (WDED);

2. Mr. I. Richard Kestner, Senior Engineering Technician, Driller, USAEHA, WDED;

3. Mr. Rocky W. Hoover, Engineering Technician, Driller's Assistant, USAEHA, WDED.

V. BACKGROUND.

A. Location. The Chester Memorial USARC is located on a 3-acre site, part of which is known as Hall Meadows. The USARC is in south-central Windsor County, Vermont, and is on the north side of Vermont Route 11, 2 miles west of the village of Chester, Vermont. The Chester Memorial USARC is located about 350 feet north of the Middle Branch of the Williams River (Figure 1). Immediately adjacent to the USARC on the east is a small motel, and farming and residential areas are located to the west, north, and south (reference 1).

B. Study Background.

1. In 1991, Fort Devens requested the USAEHA to conduct a site investigation/ geohydrologic study to examine the soils and ground water for potential contamination from a heating oil spill, within the boiler room, that supposedly entered a drain connected to the septic tank and the associated drain field sometime in 1988. Previous environmental investigations or remediation had not been performed at the Chester USARC; however, in 1978, two USTs containing heating oil were replaced and the septic tank drainage field was extended. There were no reports of any leaks from the USTs at the time of the UST replacements in 1978. Three potential sources of ground-water contamination were found during a preliminary site visit performed 31 March - 2 April 1992, and also during a geohydrologic study performed 15-20 June 1992 (reference 1).

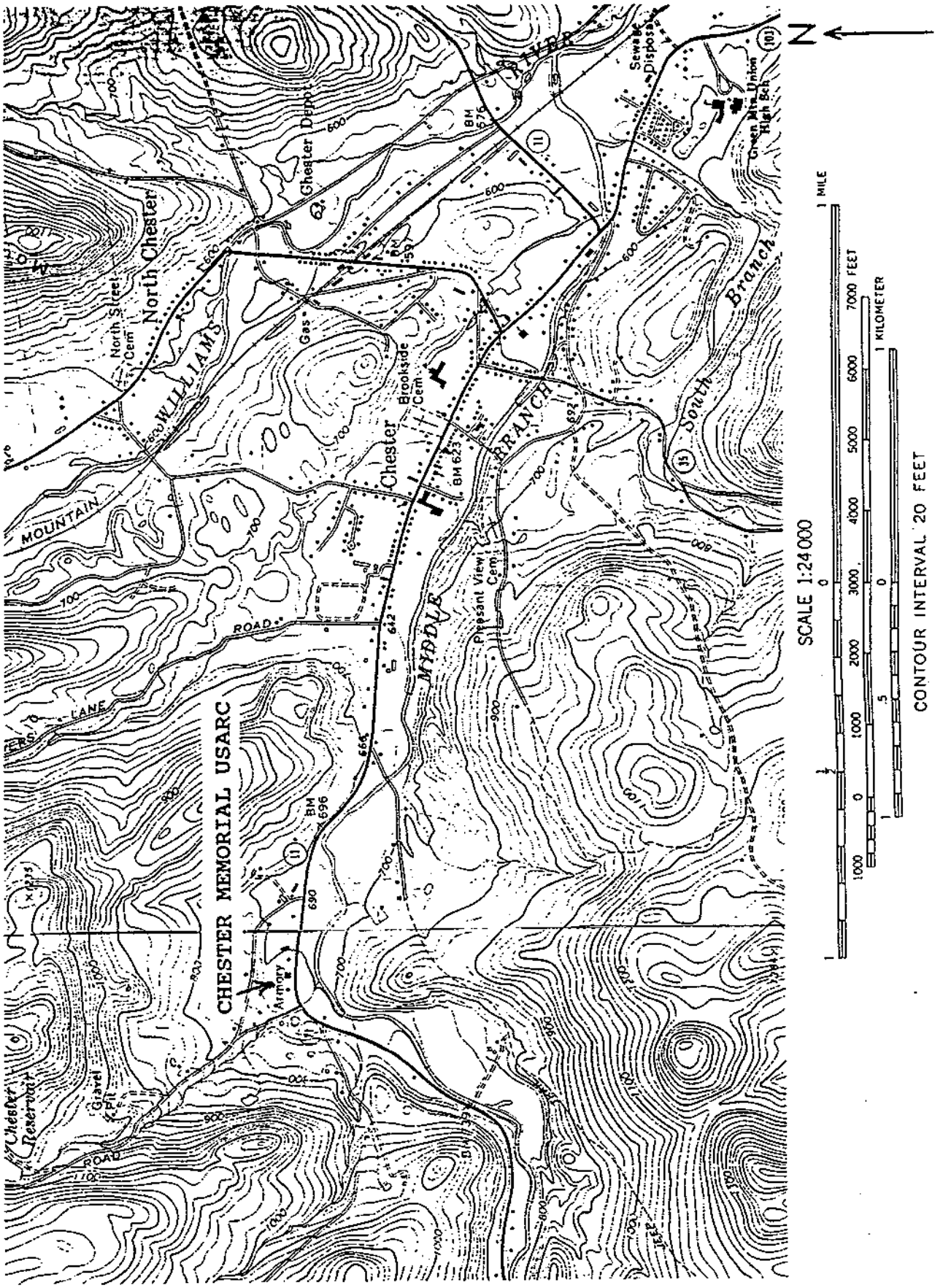

FIGURE 1. LOCATION OF THE CHESTER MEMORIAL USARC

2. The three potential sources of ground-water contamination found in 1992 were: two USTs (installed in 1978) with their associated pipelines which later were found to have leaked; a septic tank and its associated drainage field which may have contained heating oil residue from a 1988 heating oil spill; and a vehicle wash area drain with its associated oil/water separator and a dry well, which may have allowed petroleum, oil, and/or lubricants (POL) or solvents to enter the ground water.

a. In July 1992, two USTs (a 4,000-gallon single-walled fiberglass UST and a 1,000-gallon single-walled steel UST) containing heating oil were removed by a private contractor, because the UST and the associated pipe lines and/or the improperly-installed vent line were found to be leaking fuel oil (Figure 2). Both USTs were replaced with aboveground storage tanks. The contaminated soils around these leaking USTs were removed and replaced with clean soils (references 2, 3, and 4).

(1) The 4,000-gallon single-walled fiberglass UST located west of the main building was excavated and removed from the site during 27-28 July 1992. The State of Vermont Department of Environmental Conservation (DEC) was notified. Reportedly, this UST was covered with about 2 feet of sand. Soil excavated to free the tank reportedly was visibly contaminated from fuel oil, and a strong petroleum odor was evident within the excavation. Soil vertically encountered within the excavation reportedly consists of 1 to 1.5 feet of topsoil; 1.5 to 2 feet of silt with cobbles; 1 foot of very loose, light brown fine sand; 0.25 foot of pebbles and small cobbles; 0.5 foot of silt; 0.25 foot of pebbles and small cobbles; followed by 3 feet of silt with cobbles; and 0.25 foot of pebbles and small cobbles. The bottom of the initial excavation was about 9 feet below the surface. Ground water was encountered at a depth of 8.5 feet, and the private contractor observed a POL sheen on the ground-water surface. The associated piping was drained and tank connections were removed. After this UST was removed, the contractor noticed two cracks in the tank. One crack was in the fill line support and the other crack was in the bottom of the tank. Additional excavation was conducted to reach background levels [less than 1 part per million (<1.0 ppm)] using a photoionizing detector (PID) to field screen the collected soil samples for total organic vapors (TOVs). About 12 additional tons of soil were reportedly removed from the sides and the bottom of the pit (to the level of ground water) for remediation. In the process of removing contaminated soil, an 8-foot section of sewage pipe was dislodged near the northwest corner. Inspection of the area reportedly revealed that the line had been leaking for some time; however, no additional damage to the septic tank had occurred. The final excavation was approximately 12 feet deep, 12 feet wide, and 15 feet long; it was backfilled and compacted with 150 tons of clean fill on 29 July 1992 (references 2 and 3).

(2) The contractor collected eight soil samples from the original excavation walls at a depth of about 5 to 6 feet below the surface (two samples per side). The eight soil samples were analyzed (field screened) with a PID for TOV and with a nondispersive infrared

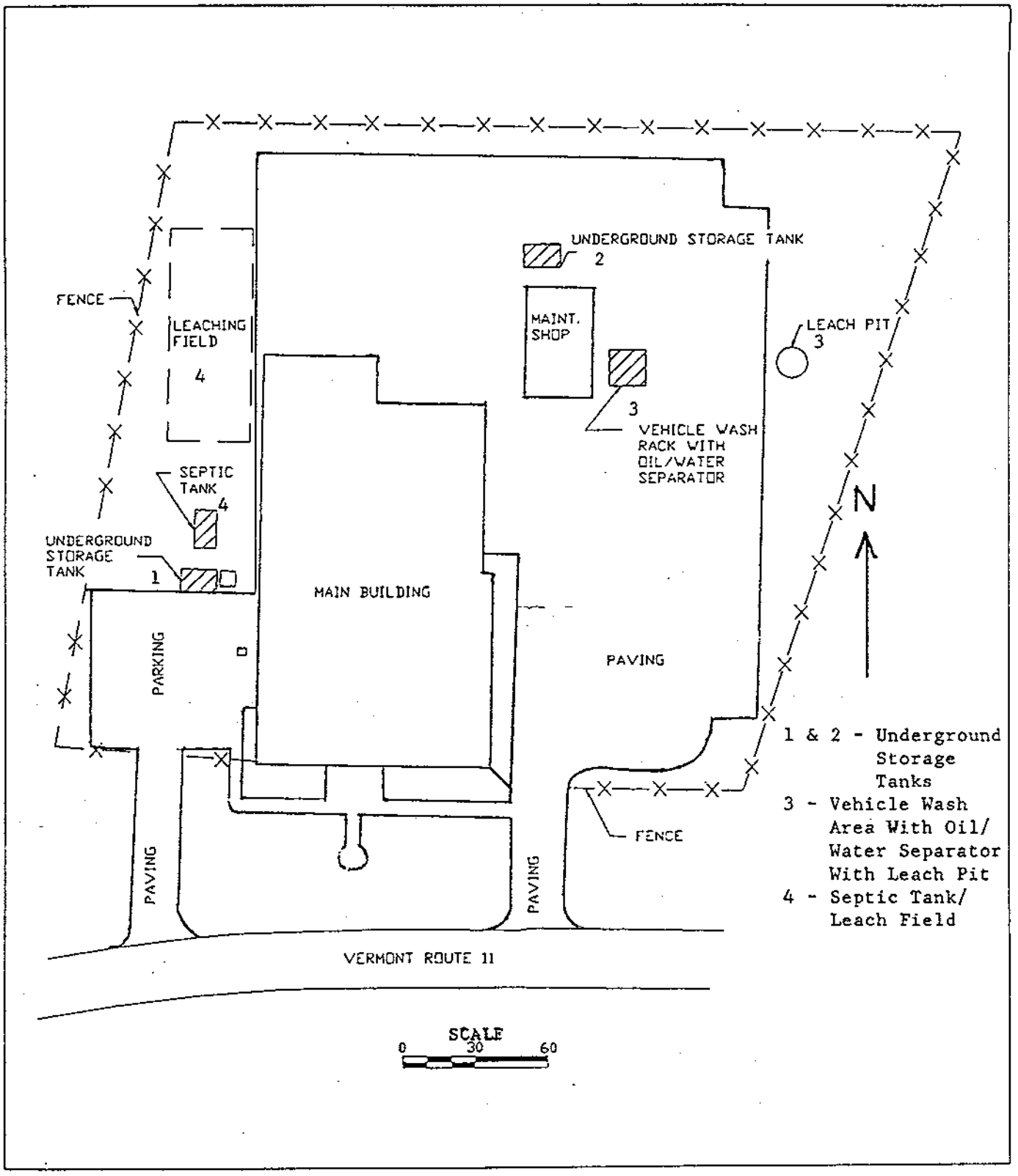

FIGURE 2. CHESTER MEMORIAL U.S. ARMY RESERVE CENTER, CHESTER, VT. SHOWING WASTE SITE LOCATIONS

(NDIR) analyzer for total petroleum hydrocarbons (TPH). The excavation wall samples were numbered consecutively in a clock-wise direction beginning near the west end of the north side. In six of the eight samples, collected on the north, south, and west sides of the pit, the PID results were all 0.0 ppm for TOVs and the NDIR results were 15.1, 30.4, 6.6, 44.4, 28.8 and 17.4 ppm of TPH, respectively. In two of the eight samples, collected on the eastern side of the pit, the PID results were 25 and 0.2 ppm for TOV and the NDIR results were 13,121.7 and 14.4 ppm of TPH, respectively. The contractor collected two soil samples from the bottom of the original excavation about 9 feet below the surface near the western and eastern sides of the pit. The PID results of these two soil samples were 1.5 and 25 ppm of TOV and the NDIR results were 22.8 and 102.5 ppm of TPH, respectively, with the higher values on the eastern side of the pit. The contractor collected a composite soil sample from the stockpiled soils and analyzed it with the PID and the NDIR. The results were 25 ppm of TOV and 23.5 ppm of TPH, respectively. The contractor collected two other soil samples from the north wall (near the northeast side), and from the bottom (east of the center of the original excavation). The laboratory analyzed the two samples for TPH and the results were 23,100 and 39 ppm, respectively. The contractor collected a ground-water sample near the center of the original excavation and the laboratory analysis for TPH was 146 ppm. Following initial PID screening, the contractor collected three additional soil samples from the post-remediated excavation for final PID field screening. One of these samples, collected from the east wall near the northeast corner, at a depth of about 5 feet below the surface, had 25 ppm of TOV. Two samples collected from the bottom of the pit near the west center, and near the east center had PID results of 1.5 and 25 ppm of TOV, respectively (references 2 and 3).

(3) The 1,000-gallon single-walled steel UST was excavated and removed from the site on 28 July 1992. Surface cover at the site consists of about 2 inches of asphalt (blacktop). Reportedly, the top of the tank was covered by 1 foot of sand and silt. Underlying the blacktop was 5 feet of fine sand and silt on top of a concrete pad. The bottom of the tank was about 5 feet below the surface; however, ground water was not encountered. Soil excavated to remove the tank was reportedly visibly contaminated, and a strong petroleum odor was evident within the excavation. The associated piping was drained and tank connections were removed. The contractor reported that the tank was in good condition without any holes, perforations, or severe corrosion; however, the vent line which had initially been improperly installed resulted in a release of fuel oil whenever the tank was filled. More excavation was required to reach background levels of less than 1.0 ppm using a PID to field screen soil samples for TOVs. About 28 additional tons of soil were removed from the west and south walls of the pit; however, further excavation could not be conducted along the south wall due to safety and potential damage to the OMS building. The excavation was backfilled and compacted with clean fill (references 2 and 4).

(4) The contractor collected eight soil samples from the original excavation walls (two samples per side) at a depth of about 3 to 4 feet below the surface for field screening with the PID and field analysis with an NDIR analyzer. The excavation wall samples were numbered consecutively in a clock-wise direction beginning near the west end of the north side. The PID and NDIR results of soil samples collected from the north and east walls were 0.2 ppm of TOVs and 20.5 ppm of TPH, 0.0 ppm of TOVs and 25.2 ppm of TPH, 0.2 ppm of TOVs and 22.8 ppm of TPH, and 0.0 ppm of TOVs and 20.2 ppm of TPH, respectively. The two samples collected from the south wall had 0.4 and 6.0 ppm of TOV and 34.8 and 64.5 ppm of TPH, respectively. The two samples collected from the west wall had 1.5 and 18.0 ppm of TOV and 14.9 and 51.3 ppm of TPH, respectively. The highest PID results were found on the western side and the higher NDIR results were found near the southwest and northwest corners. Two soil samples were collected for field screening with the PID and field analyses with an NDIR analyzer from the bottom of the original excavation in the center of the western and eastern sides of the pit about 5 feet below the surface. The PID results were 10 and 2 ppm of TOV and the NDIR results were 33.6 and 80.5 ppm of TPH, respectively. Two composite soil samples were collected from stockpiled soils for PID and NDIR screening. The PID results were 20 and 2 ppm of TOV, and the NDIR results were 3169.3 and 168.8 ppm of TPH. Two other soil samples, collected from the south wall and from the bottom near the center of the original excavation, were analyzed for TPH. The laboratory results were 653 and 22 ppm of TPH, respectively. Following initial PID screening, two additional soil samples were collected from the post-remediated excavation from the western walls of the enlarged pit for PID and TPH laboratory analyses. The PID results for both samples were 0.0 ppm of TOV, one sample was field screened for NDIR and the result was 10.8 ppm of TPH and the laboratory results for TPH for the other sample was <1.0 ppm (reference 4).

b. The septic tank is located west of the main building, and the associated drainage field is located north of the septic tank (Figure 2). In 1988, an unknown quantity of heating oil from the boiler room leaked and supposedly migrated via a floor drain connection to the septic tank, and thence to the drain field.

c. The vehicle wash area drain is located about 12 feet north and 12 feet east from the southeast corner of the OMS building. An associated oil/water separator, empties into a dry well and/or leaching pit (Figure 2). A possibility exists that oil or solvents and other fluids used in vehicle maintenance may have bypassed the oil/water separator and entered the dry well leach field, and possibly entered the ground water.

VI. FINDINGS AND DISCUSSION.

A. Ground-Water Monitoring Well Installation.

1. Three additional ground-water monitoring wells (Nos. 7, 8, and 9) were drilled from 26-27 April 1993 (Figure 3) using a Mobile B-80®, which was equipped to drill with either the hollow-stem auger or air rotary methods; however, only the hollow-stem auger method was used. No soil discoloration or petroleum odors were noticed during the drilling of wells Nos. 7 and 8; however, there were soil discolorations and/or petroleum odors noticed while drilling well No. 9. Appendix B describes the field methods used to drill these three wells, Appendix C contains the drilling logs, Appendix D contains the Field Data Log Sheets, and Appendix E contains the Ground-Water Monitoring Well Summary.

2. Wells Nos. 7, 8, and 9 were drilled to a depth of 21.03, 14.58, and 13.22 feet below ground surface, respectively. The polyvinyl chloride (PVC) riser pipes on wells Nos. 7 and 9 were 1.45 and 2.21 feet above the ground surface, respectively. The PVC riser pipe on well No. 8 was 0.15 foot below the ground surface, as this well was fitted with a flush-mount top to allow vehicles to pass over this well.

B. Direction of Ground-Water Flow. Because no topographic benchmarks were found, relative elevations of the tops of the nine PVC well casings were determined to the nearest 0.01 foot. The height of the PVC well casings above and below the ground surface were measured to the nearest 0.01 foot. Table 1 shows the relative elevations of the top of the riser pipes of wells Nos. 1-6 which were surveyed by Messrs. Kestner and Hoover on 17 June 1992, wells Nos. 7-9 which were surveyed by Messrs. Kestner and Hoover on 28 April 1993, and the relative elevations of the water surfaces which were measured on 28 April 1993. Figure 4 is a map showing approximate contour lines of the water table surface with arrows showing the direction of ground-water flow. Ground water flows towards the southeast.

C. Developing and/or Purging the Ground-Water Monitoring Wells. Wells Nos. 1-7 and 9 were developed and/or purged prior to sampling on 28 April 1993 using 2-inch diameter stainless steel bailers, and well No. 8 was developed and/or purged prior to sampling using a 2-inch diameter Teflon® bailer. During the developing and/or purging phase, 10 gallons of ground water were removed (or purged) from wells Nos. 1, 2, 4, 5, 6, and 8. None of these

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® Teflon is a registered trademark of E.I. DuPont de Nemours & Co., Inc., Wilmington, Delaware.

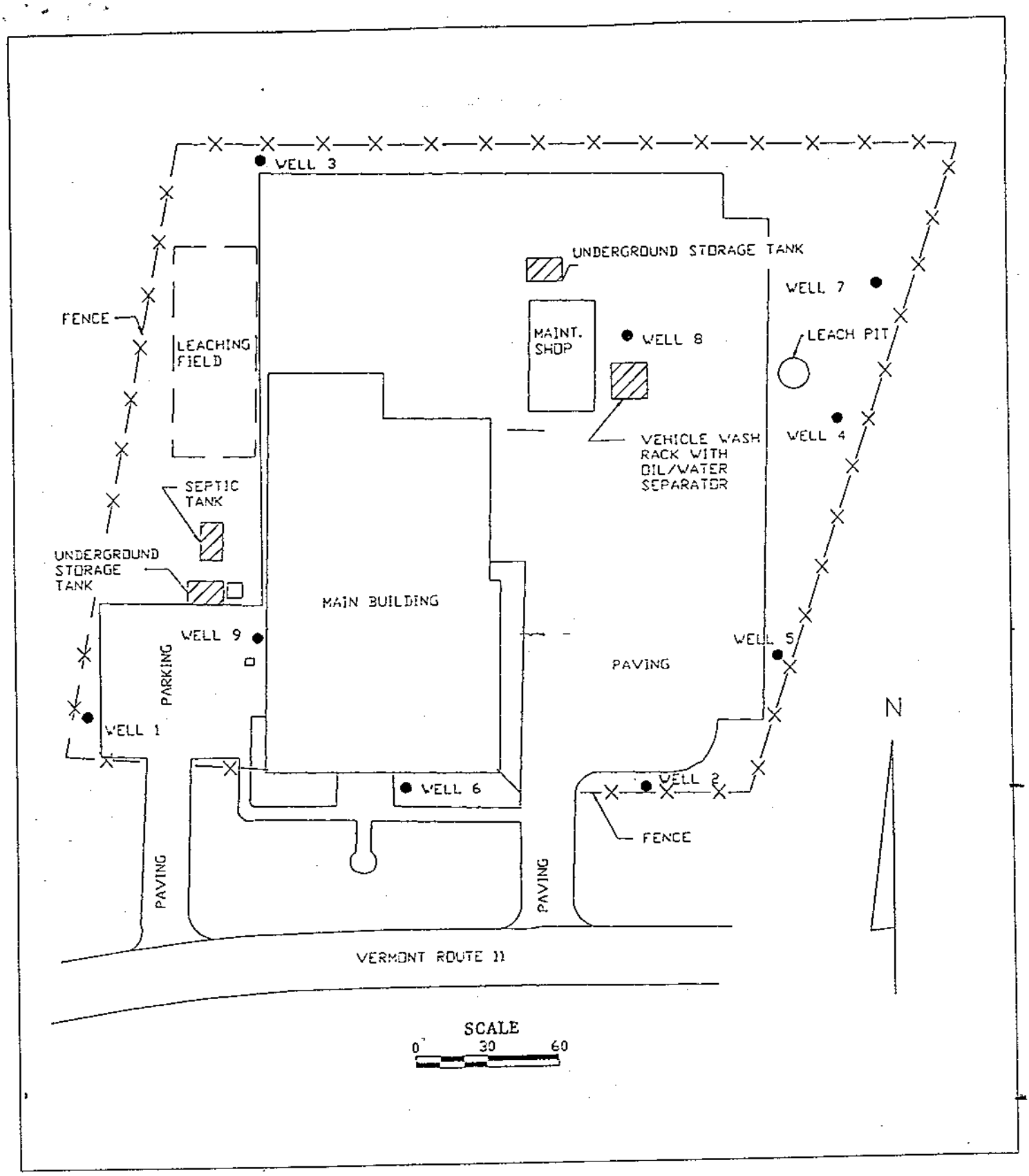

FIGURE 3. CHESTER MEMORIAL U.S. ARMY RESERVE CENTER, CHESTER, VT. SHOWING WASTE SITE LOCATIONS AND LOCATIONS OF NINE GROUND-WATER MONITORING WELLS

TABLE 1. RELATIVE ELEVATIONS IN FEET OF THE RISER PIPES AND THE TOP OF THE GROUND-WATER SURFACE OF THE SIX GROUND-WATER MONITORING WELLS AT THE CHESTER MEMORIAL USARC

Well Number	Relative Elevation of Top of Well Riser Pipe	Distance From Water Surface	Relative Elevation of Water Surface
1	51.22	8.39	42.83
2	50.35	12.38	37.97
3	49.56	3.56	46.00
4	47.84	9.13	38.71
5	48.38	10.13	38.25
6	49.52	9.10	40.42
7	46.09	6.27	39.82
8	46.62	5.93	40.69
9	51.34	8.70	42.64

six wells were bailed dry. Twenty-five gallons of ground water were purged from well No. 7 and it did not bail dry. More than nine times the standing water volume in this particular well was removed prior to collecting the ground-water sample. Only about 2.5 gallons of ground water were purged from well No. 3 before it went dry. Well No. 3 was bailed twice to purge 5 gallons of water prior to collecting a ground-water sample. Only about 1.25 gallons of ground water were purged from well No. 9 before it went dry. This well was bailed twice to purge 2.5 gallons of water prior to collecting a ground-water sample. See Appendix B for a description of the well developing method.

D. Sampling the Ground-Water Monitoring Wells. All nine ground-water wells were considered sufficiently purged prior to collecting ground-water samples for volatile organic compounds (VOCs) and acid and base/neutral semivolatile organic compounds (SVOCs). More than three times the standing water volume in wells Nos. 1, 2, 4 through 8, and 9 were removed prior to sampling. See Appendix B for a description of the well sampling method.

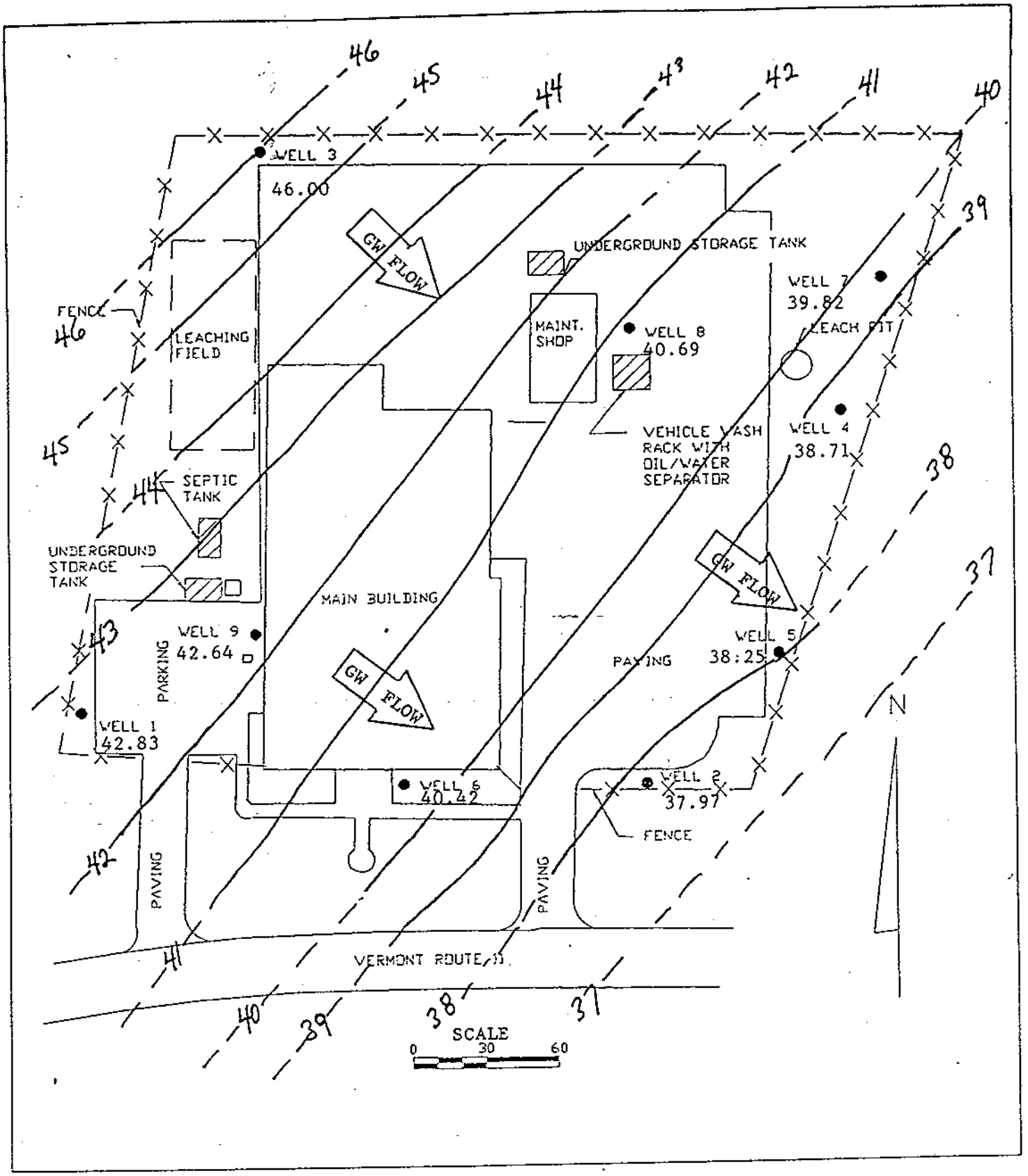

FIGURE 4. APPROXIMATE CONTOUR LINES OF THE GROUND-WATER TABLE WITH ARROWS SHOWING DIRECTION OF GROUND-WATER FLOW

E. Chemical Analyses of Soil and Ground Water.

1. General. No soil staining or odor of fuel oil were noticed during the drilling of well No. 7; therefore, no soil samples were collected from this particular well for VOC scans or TPH. However, because wells Nos. 8 and 9 were located near and downgradient from the two removed USTs, soil samples for VOC scans and TPH were collected in glass jars with Teflon-lined lids during the drilling of these two particular wells. Three soil samples for VOC and TPH were collected from well No. 8 at depths of 5 to 7, 8 to 10, and 10 to 12 feet, respectively, from well No. 9 at depths of 0 to 4, 7.5 to 9, and at 12 feet, respectively. These six soil samples were collected on 27 April 1993, received in the USAEHA Organic Environmental Chemistry Division (OECD) laboratory on 3 May 1993, and analyzed on 10 May 1993. The sample holding time of 14 days for all soil samples was met. See Appendix B for a description of the soil sampling method.

2. Volatile Organic Analyses of Soil Samples.

a. A relatively small amount [i.e., 26 micrograms per kilogram (μg/kg) or parts per billion (ppb)] of p-isopropyltoluene was detected in one of the six soil samples collected from the newly-installed ground-water monitoring wells (i.e., well No. 9 at the 12-foot depth). In addition, the chromatogram of that particular sample showed a large hump which contained a variety of unknown and possibly weathered hydrocarbons. These possibly weathered hydrocarbons were not identified; however, the concentration inside the hump was estimated at 13,000 μg/kg. There were no other significant target compounds (less than 15 μg/kg based on fluorobenzene) present in any other soil sample. No tentatively identified volatile compounds (TICs) were detected. There are no pertinent standards for organics in soil. A list of the VOCs analyzed and their respective detection limits are shown in Appendix F.

b. Volatile organic compounds normally will eventually escape to the atmosphere through the porous soils within the vadose zone. One surrogate recovery failed the imposed acceptable limits in the soil sample collected at the 12-foot depth from well No. 9. Retention times and internal standard area counts complied with the method quality control (QC) requirements. A matrix spike was performed on the soil sample from well No. 8 at the 5- to 7-foot depth with acceptable recoveries for every compound spiked.

3. Analyses of Soil Samples for TPH.

a. Eight soil samples (six samples from wells Nos. 8 and 9 and two samples from below the concrete floor of the boiler room) were extracted on 6 May 1993 and analyzed for TPH content (measured as diesel range organics). The analytical results are contained in

Table 2, which shows the presence of TPH at 66 micrograms per gram (μg/g) or parts per million (ppm) from well No. 9 at the 12-foot depth. None of the remaining five soil samples from wells Nos. 8 or 9 indicated any TPH above the analytical detection limit of 4 μg/g.

TABLE 2. ANALYTICAL RESULTS FOR TOTAL PETROLEUM HYDROCARBON (DIESEL RANGE ORGANICS) OF SOIL SAMPLES COLLECTED DURING DRILLING AND ALSO FROM SMALL DIAMETER HOLES DRILLED IN THE BOILER ROOM

Sample Description	Date Collected	Percent of Terphenyl Recovered	Amount of TPH in μg/g
Well No. 8 (5-7')	27 Apr 93	109 Percent	< 4.0
Well No. 8 (8-10')	27 Apr 93	65 Percent	< 4.0
Well No. 8 (10-12')	27 Apr 93	83 Percent	< 4.0
Well No. 9 (0-4')	27 Apr 93	90 Percent	< 4.0
Well No. 9 (7.5-9')	27 Apr 93	67 Percent	< 4.0
Well No. 9 (at 12')	27 Apr 93	41 Percent	66.0
Hole No. 1 (Boiler Room)	29 Apr 93	31 Percent	53.0
Hole No. 2 (Boiler Room)	Sample Lost During Concentration Process		

b. Because of the reported 1988 heating oil spill in the boiler room, six 1-inch diameter holes were drilled on 27 April 1993 into the floor of the boiler room to check on the occurrence of No. 2 fuel oil underneath the building (Figure 5). These holes were drilled to a depth of about 1 foot with an electric hammer drill. Four of the six holes did not show any PID indication of No. 2 fuel oil; however, a PID indication and an oil odor were present in the other two holes. Following initial PID screening, two soil samples were collected for TPH analyses from the two holes which indicated the presence of fuel. Table 2 shows the analytical result (i.e., 53 μg/g of TPH) from one of these two drilled holes; however, the soil sample from the other hole was lost during the concentration process.

c. The soil samples were extracted with methylene chloride using a U.S. Environmental Protection Agency approved sonication procedure (EPA Method 3550) and quantitatively analyzed by a gas chromatographic method of analysis [OECD standard operating procedure (SOP) 132.1]. This method is based on reference 5. Sonication is the process of using high frequency sound waves to disrupt and extract analytes of interest from a matrix.

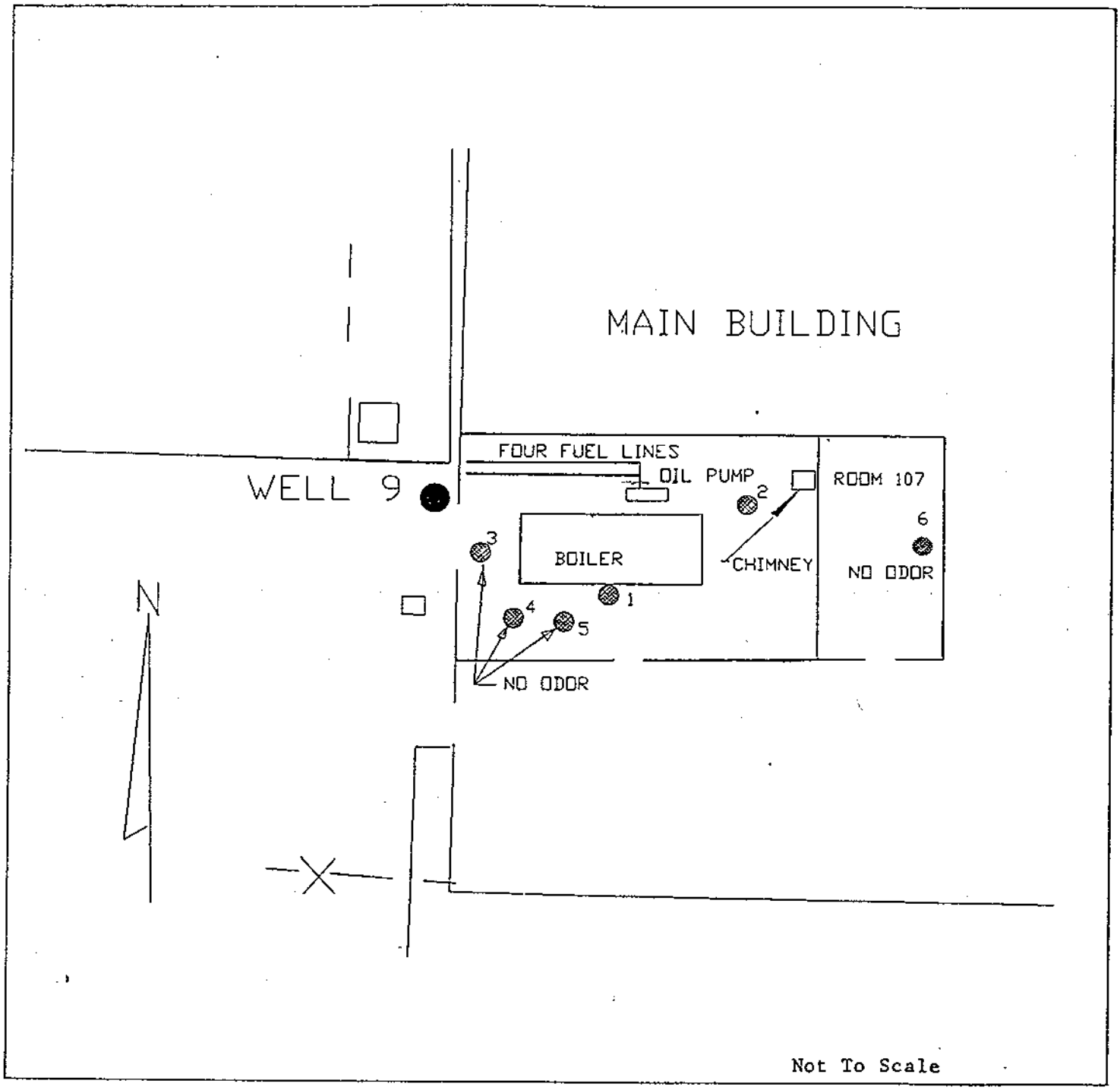

FIGURE 5. MAP SHOWING LOCATIONS OF SIX 1-INCH DIAMETER HOLES DRILLED INTO THE BOILER ROOM FLOOR

d. Two soil samples were spiked with No. 2 fuel oil at a level of 83 μg/g and recovered at levels 72 percent and 94 percent. Extraction efficiencies of the samples were monitored by the percent recovery of the terphenyl surrogate and are listed in Table 2. Personnel in the OECD laboratory believe that the low recoveries of the surrogate compound in the two soil samples, which were collected from well No. 9 at the 12-foot depth and the small diameter drilled hole in the boiler room, were due to co-eluting compounds found in the samples.

4. Volatile Organic Analyses of Ground-Water Samples.

a. Ground-water samples from wells Nos. 1-9 were collected on 28 April 1993, received in the laboratory on 3 May 1993, and analyzed on 11 May 1993. The holding time of 14 days for all the ground-water samples was met. See Appendix B for a description of the ground-water sampling method. A list of the VOCs analyzed and their respective detection limits are shown in Appendix F. Four target and seven nontarget compounds were detected in the ground-water sample from well No. 9. The analytical results are shown in Table 3. There were no target nor substantial nontarget compounds detected in any other ground-water sample. None of the VOCs present in the ground-water samples at the Chester Memorial USARC exceeded the National Primary Drinking Water Regulations (NPDWR).

TABLE 3. VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUND-WATER SAMPLES COLLECTED FROM WELL NO. 9 AT THE CHESTER MEMORIAL USARC

Organic Compound	CAS Number*		Amount in micrograms per liter (μg/L)
Benzene	71-43-2		3.0
p-Isopropyltoluene	99-87-6		5.0
1,2,4-Trimethylbenzene	95-63-6		3.0
1,3,5-Trimethylbenzene	108-67-8		5.0
Benzene,1Meth-3-(1 Methethyl)	535733	estimated value	15.0
Unknown		estimated value	10.0
Benzene,1,2,3,4-Tetramethyl	488233	estimated value	10.0
1H-Indene,2,3-Dihyd-5-Methyl	874351	estimated value	15.0
1H-Indene,2,3-Dihyd-2-Methyl	824635	estimated value	25.0
Naphtalene,1,2,3,4-Tetrahyd	119642	estimated value	10.0
1H-Indene,2,3-Dihyd-4,7-Dime	6682719	estimated value	20.0

* CAS Number is derived from the Chemical Abstract Service.

b. The surrogate recoveries for all the ground-water samples were acceptable with all the values meeting the QC limits imposed. A matrix spike was performed on the ground-water sample from well No. 1 with acceptable recoveries for all the spiked compounds. All internal standard area counts and retention times complied with the method QC requirements.

5. Acid and Base/Neutral Semivolatile Organic Analyses of Ground-Water Samples. These ground-water samples were analyzed by EPA Method 8270. No problems were encountered during the extraction of these samples. All samples were analyzed for the target compound list. A list of the SVOCs analyzed and their respective detection limits are shown in Appendix F. In the sample collected from well No. 3, the surrogate recovery of 2-fluorophenol was outside the QC limits. The recovery was, however, greater than 10 percent. All other QC was within specifications.

a. There were no detections of SVOCs or TICs in the ground-water sample collected from well No. 1; however, there was one TIC (a trace of less than 10 µg/L) of unknown SVOCs detected in the samples collected from wells Nos. 2, 5, and 8. There were traces of two TICs in the sample collected from well No. 3. Larger amounts of unknown SVOCs and unknown alkanes were detected in ground-water samples collected from wells Nos. 4, 6, and 7. However, much larger amounts and more unknown SVOCs including more unknown alkanes, were detected in ground-water samples collected from well No. 9.

b. Alkanes are hydrocarbons containing no unsaturation (double bonds). Alkanes can be straight or branched chained bonds. The only known TIC detected without having an estimated concentration was 2-methylnaphthalene at 29.0 µg/L in well No. 9. The analytical results showing the SVOCs and TICs detected in the wells at Chester Memorial USARC are shown in Table 4.

c. None of the SVOCs present in the ground-water samples at the Chester Memorial USARC exceeded the NPDWR.

VII. CONCLUSIONS.

A. Three additional ground-water monitoring wells were installed at the Chester Memorial USARC. Ground-water and soil samples for VOCs and TPH were collected and analyzed. Water levels were measured, and relative ground surface elevations at each well were determined. Ground water flows toward the southeast.

B. The chemical analyses from the ground-water and soil samples confirmed that a leak of fuel oil had occurred from the previous 4,000-gallon UST and/or from a spill of fuel oil within the boiler room.

TABLE 4. SEMIVOLATILE ORGANIC COMPOUNDS AND TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN GROUND-WATER SAMPLES COLLECTED FROM GROUND-WATER MONITORING WELLS AT THE CHESTER MEMORIAL USARC

Well Number	Organic Compound		Amount in micrograms per liter (µg/L)
2	Unknown	estimated value	6.0
3	Unknown	estimated value	9.0
3	Unknown	estimated value	7.0
4	Unknown	estimated value	4.0
4	Unknown	estimated value	36.0
5	Unknown	estimated value	5.0
6	Unknown	estimated value	54.0
7	Unknown	estimated value	36.0
8	Unknown	estimated value	7.0
9	2-methylnaphthalene		29.0
9	Unknown alkane	estimated value	45.0
9	Unknown	estimated value	33.0
9	Unknown	estimated value	37.0
9	Benzene, 1,2,3,4-tetramethyl	estimated value	36.0 X
9	Unknown alkane	estimated value	38.0
9	Unknown aromatic	estimated value	33.0
9	Unknown alkane	estimated value	89.0
9	Naphthalene, 1-methyl-	estimated value	32.0
9	Unknown alkane	estimated value	32.0
9	Unknown alkane	estimated value	87.0
9	Naphthalene, 1,2,3,4-tetrahy	estimated value	30.0 X
9	Naphthalene, 1,3-dimethyl-	estimated value	88.0 X
9	Unknown alkane	estimated value	32.0
9	Unknown alkane	estimated value	73.0
9	Unknown alkane	estimated value	79.0
9	Unknown alkane	estimated value	44.0
9	Unknown alkane	estimated value	120.0
9	Unknown alkane	estimated value	75.0
9	Unknown	estimated value	58.0
9	Unknown alkane	estimated value	72.0
9	Unknown alkane	estimated value	40.0
9	Unknown alkane	estimated value	56.0
9	Unknown alkane	estimated value	41.0
9	Unknown alkane	estimated value	35.0
9	Unknown	estimated value	100.0

The X denotes an Isomer of the listed compound.

C. None of the VOCs nor SVOCs detected in the ground water exceeded the NPDWR.

D. Both USTs have been removed by a private contractor, and the bulk of the contaminated soil surrounding these USTs has also been removed. Therefore, the source of the fuel oil leaks no longer exists. The soil and ground water near one of these USTs indicate that a leak had occurred; however, the contamination is relatively small, has been undergoing weathering, and poses no hazard to human health or to the environment.

VIII. RECOMMENDATION. Coordinate the data and interpretations presented in this report with the Sites Management Section, Hazardous Materials Management Division of the State of Vermont's Department of Environmental Conservation.

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APPROVED:

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APPENDIX A

REFERENCES

1. Memorandum, USAEHA, HSHB-ME-SG, 7 October 1992, subject: Geohydrologic Study No. 38-26-KL45-92, U.S. Army Reserve Center-Chester, Chester, Vermont, 15-20 June 1992.

2. Memorandum For Record, AFZD-EM, 30 July 1992, subject: Trip Report, Underground Storage Tank Removal, U.S. Army Reserve Center, Chester, Vermont.

3. Post-Removal Report, Underground Storage Tank Closure, 4,000 Gallon, No. 2 Fuel Oil, UST No. 0127, U.S. Army Reserve Center, Building P-1, State Route 11, Chester, Vermont, prepared by ATEC Environmental Consultants, 19 August 1992.

4. Post-Removal Report, Underground Storage Tank Closure, 1,000 Gallon, No. 2 Fuel Oil, UST No. 0126, U.S. Army Reserve Center, Building P-2, State Route 11, Chester, Vermont, prepared by ATEC Environmental Consultants, 19 August 1992.

5. "Method for the Determination of Diesel Range Organics," Revision 3, 8 May 1992, prepared by the American Petroleum Institute.

APPENDIX B

DESCRIPTION OF FIELD METHODS

1. DRILLING EQUIPMENT AND DRILLING METHODS.

a. The air rotary method uses an air percussion/rotary drill bit and hollow steel rods to carry the pressured air down and out the drill bit. The pressured air blows the rock cuttings from the hole. No drilling fluids other than natural ground water are utilized during the drilling. However, all of these three newly installed wells were drilled using the auger method.

b. The auger method uses a cutterhead and continuous spiraling flights around a hollow core. The continuous spiraling flights act as a screw conveyer and allow continuous cleaning of the cuttings from the hole during drilling. The auger has a 6.25-inch outside diameter (OD) and the hollow core has a 3.25-inch inside diameter (ID). Each auger is 5 feet in length, and they are joined together using two opposite-facing screws at the base of each auger. A center steel stem (rod) is normally inserted through the hollow auger core with its own drill bit for drilling through indurated soil, silt, clay, and shale. During the drilling of softer material, a plastic basket is mounted between the leading auger flight and the cutterhead to prevent soil from entering the core of the auger when the center steel rod is not used. The wells were completed at a depth from about 10 to 15 feet below the water table. No drilling fluids other than natural ground water were utilized during the drilling.

2. CLEANING METHODS. The drilling rig, auger flights, and other associated equipment and tools were cleaned with high pressure water or the hot water supplied by the Chester Memorial USARC.

3. WELL INSTALLATION MATERIALS AND METHODS. The monitoring wells were completed using 2-inch ID PVC well casing and preslotted well screen (0.01-inch slot size) with flush-threaded joints (Figure B-1). Clean, bagged, dry medium to coarse quartz (silica) sand (white swimming pool filter sand) was slowly poured down the outside of each well and around the annular space surrounding the well screen. The sand level was measured in each well and brought up above the top of the well screen. A seal of bentonite was placed above the sand pack. The bentonite used was in 1/4-inch pellets in 5-gallon buckets. Bentonite is a clay, formed from the decomposition of volcanic ash, which has the capacity to adsorb or absorb water which causes it to swell when wet to about five times its dry volume; therefore, it is used to seal the sand pack from percolating water. Concrete was mixed with water and used to fill the remaining annular space to the surface. A steel protective casing with a hinged locking cap was installed around the PVC riser pipe and pushed into the wet concrete.

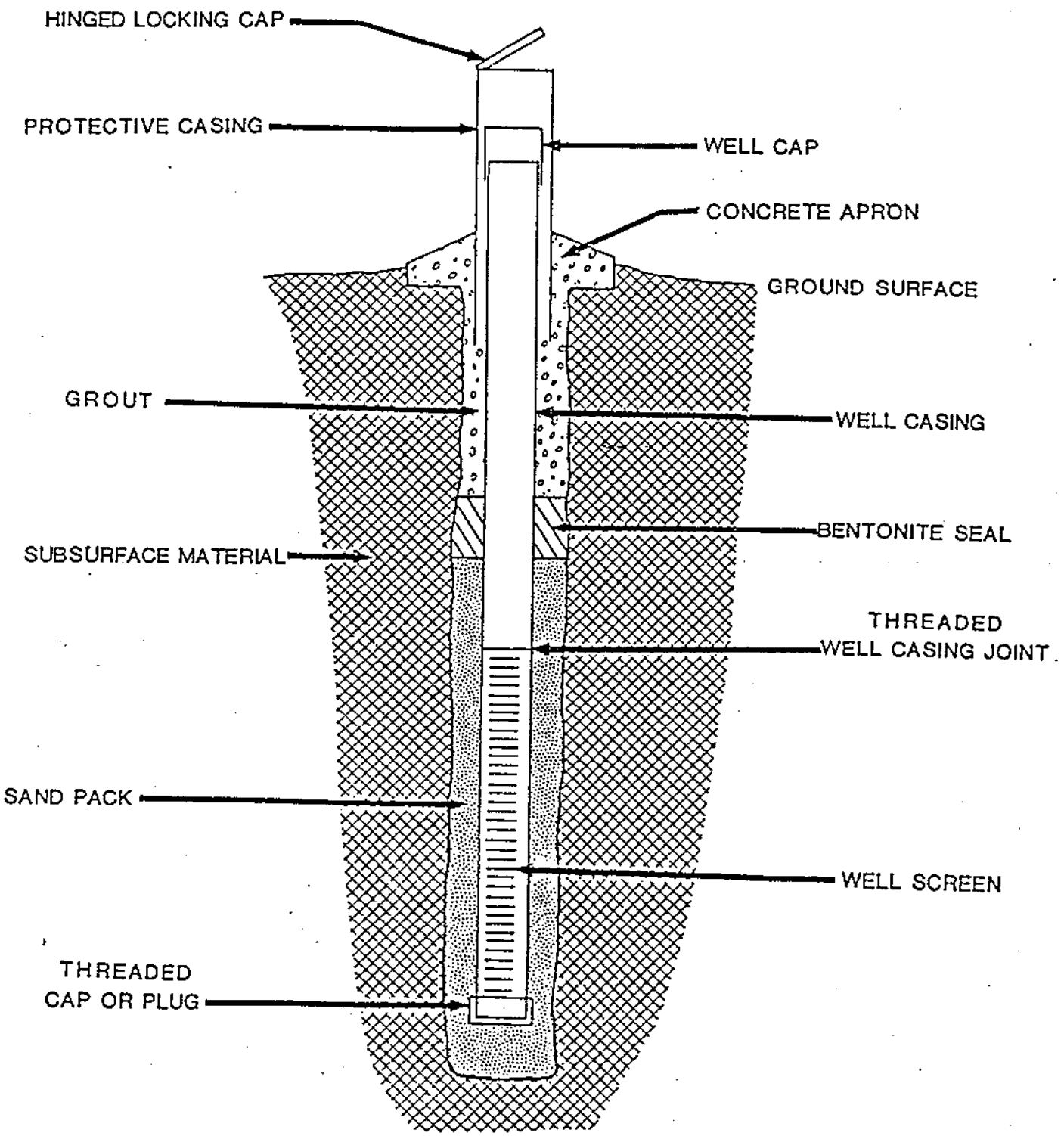

FIGURE B-1

GENERALIZED MONITORING WELL CONSTRUCTION

4. MONITORING WELL DEVELOPMENT. Monitoring well development was accomplished by bailing and surging. The bailers used were either made from stainless steel, Teflon, or a Singlesample® disposable bailer. In order to eliminate cross-contamination from well to well, the stainless steel or Teflon bailers were washed with Alconox®, rinsed with tap water, and rinsed again with distilled water prior to their being used again. For each monitoring well, the water level was determined using an electric (battery-operated) water level indicator. The volume of standing water in each well was calculated from this measurement. Development is considered sufficient when the well was bailed dry two or more times or when relatively clean water was retrieved from the well during development. However, the water did not become relatively clear during the bailing from these nine wells. There was always fine micaceous silt and sand in the bailer even after bailing as much as 25 gallons (about 9 volumes) from well No. 7 and 10 gallons from most of these wells. Wells Nos. 3 and 9 were bailed dry and recharged slowly; however, they were bailed dry two times. The other seven wells did not go dry during bailing. No additional water or air was introduced into the monitoring well during development.

5. DETERMINING THE RELATIVE ELEVATIONS. Relative elevations of the top of the PVC riser pipe and the ground level adjacent to the well were surveyed by USAEHA personnel on 17 June 1992 (wells Nos. 1-6) and on 28 April 1993 (wells Nos. 7-9). The relative elevations of the tops of the PVC riser pipe for wells Nos. 1-9 are: 51.22, 50.35, 49.56, 47.84, 48.38, 49.52, 46.09, 46.62, and 51.34 feet, respectively. The elevations were needed to determine the direction of ground-water movement following the measurements of the top of the water surface in each well. Ground water moves toward the southeast.

6. GROUND-WATER MONITORING WELL SAMPLING METHODS. For each monitoring well, the water level was determined using an electric (battery-operated) water level indicator. The volume of standing water in each well was calculated from this measurement. Prior to sampling, the wells had at least three well volumes of water removed or they were bailed dry using a stainless steel or a Singlesample disposable bailer. Water samples were collected as soon as the well recovered or immediately after purging. The ground-water samples were placed in containers supplied by the USAEHA laboratories and preserved as specified by the laboratories.

7. SOIL SAMPLING. Soil samples for chemical analyses were randomly collected in glass jars with a Teflon-lined cap, during the drilling of two of three ground-water monitoring wells, on a grab-sample basis. Clean, rubber surgical gloves were worn whenever soil was hand-collected and placed into these jars. These gloves were changed for each sample. Soil samples were collected and analyzed for VOC scans, and TPH.

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APPENDIX C

DRILLING LOGS

US ARMY ENVIRONMENTAL HYGIENE AGENCY
DRILLING LOG

(The proponent of this form is HSHB-ES)

INSTALLATION Chester Memorial USARC, Chester, Vermont
PROJECT NUMBER 38-26-KL45-93
LOCATION Northeast corner of site. About 67 ft S from north fence and about 8.8 feet W from east fence.
DRILL RIG Mobile B-80 W/6-in. hollow-stem auger
DATE 26 April 1993
GEOLOGIST David C. Bayha
DRILLER AND HELPER I. Richard Kestner, Senior Engineering Technician and Rocky W. Hoover, Engineering Technician
BORE HOLE Well 7 (Downgradient)

DEPTH	SAMPLE TYPE	DESCRIPTION	REMARKS
		Medium brown sandy, silty, micaceous clay with some small pebbles.	Light rain this morning. Soil is moist to almost wet. Somewhat plastic Easy drilling.
4.8′		Top of Water Table	
5′			
6′			
6.5′		Encountered gravel layer.	
		Medium brown sandy, silty, micaceous clay with small pebbles and cobbles.	Saturated. Somewhat stiff to easy drilling
10′			
15′			

AEHA Form 130, 1 Nov 82
Replaces HSHB Form 78, 1 Jun 80, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

(The proponent of this form is HSHB-ES)

INSTALLATION Chester Memorial USARC, Chester, Vermont
PROJECT NUMBER 38-26-KL45-93
LOCATION Northeast corner of site. About 67 ft S from north fence and about 8.8 feet W from east fence.
DRILL RIG Mobile B-80 W/6-in. hollow-stem auger
DATE 26 April 1993
GEOLOGIST David C. Bayha
DRILLER AND HELPER I. Richard Kestner, Senior Engineering Technician and Rocky W. Hoover, Engineering Technician
BORE HOLE Well 7 (Downgradient)

DEPTH	SAMPLE TYPE	DESCRIPTION	REMARKS
15'		Same as above.	
20'			
21'	------	Bottom of Hole----------	----------
		Added 15 feet of 0.01 inch slot-sized PVC screen with well point and 10 feet of solid PVC casing. Total amount of PVC casing and screen in hole was 25.43 feet; however, 2.95 feet was cut off. The total amount of PVC pipe in hole is 22.48 feet. The top of the PVC riser pipe is 1.45 feet above ground surface.	
		Added 4 each 50-lb bags of swimming pool filter sand. Top of the sand is at 2.6 feet below the ground surface.	
		Added 0.5 bucket of bentonite pellets. Top of dry bentonite at 0.9 feet below the ground surface.	

AEHA Form 130, 1 Nov 82
Replaces HSHB Form 78, 1 Jun 80, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

(The proponent of this form is HSHB-ES)

INSTALLATION Chester Memorial USARC, Chester, Vermont
PROJECT NUMBER 38-26-KL45-93 DATE 27 April 1993
LOCATION About 7.3 feet east from the east side of the maintenance Bldg. & 16.5 feet south from NE corner of Bldg. GEOLOGIST David C. Bayha
DRILLER AND HELPER I. Richard Kestner and Rocky W. Hoover
DRILL RIG Mobile B-80 W/6-in. hollow-stem auger BORE HOLE Well 8 (Downgradient)

DEPTH	SAMPLE TYPE	DESCRIPTION	REMARKS
0.33'	------	Asphalt cover over parking lot---	----------
		Gravel and small to large cobbles and medium brown sandy, silty micaceous clay.	Dry to damp. Not plastic. Medium to hard drilling.
5'	------	----------	----------
	Soil Sample 5-7 ft	Medium brown sandy, silty, clay with mica flakes. Some gravel & small cobbles. Mostly gravel.	Hard drilling. Dry to moist Not too plastic.
7'	------	----------	----------
		Same as above.	
8'	------	----------	----------
	Soil Sample 8-10'	Medium brown sandy, silty, clay with mica flakes. Some gravel & very few small cobbles.	Very moist to almost wet. Hit water at 8 or 9'
10'	------	----------	----------
	Soil Sample 10-12'	Medium brown sandy, silty, clay with mica flakes. No fuel oil odor.	Wet, plastic.
12'	------	----------	----------
		Medium brown sandy, silty, micaceous clay.	
14.6	------	Bottom of Hole----------	----------

AEHA Form 130, 1 Nov 82
Replaces HSHB Form 78, 1 Jun 80, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

(The proponent of this form is HSHB-ES)

INSTALLATION Chester Memorial USARC, Chester, Vermont
PROJECT NUMBER 38-26-KL45-93
LOCATION About 7.3 feet east from the east side of the maintenance Bldg. & 16.5 feet south from NE corner of Bldg.
DRILL RIG Mobile B-80 W/6-in. hollow-stem auger
DATE 27 April 1993
GEOLOGIST David C. Bayha
DRILLER AND HELPER I. Richard Kestner and Rocky W. Hoover
BORE HOLE Well 8 (Downgradient)

DEPTH	SAMPLE TYPE	DESCRIPTION	REMARKS
		Added 10 feet of 0.01 inch slot-sized PVC screen with well point and 5 feet of solid PVC casing. Total amount of PVC casing and screen in hole was 15.43 feet; however, 1.0 foot was cut off. The total amount of PVC pipe in hole is 14.43 feet. The top of the PVC riser pipe is 0.15 foot below the ground surface inside of a flush-mount top to allow vehicles to pass over this well. Added 3 each 50-lb bags of swimming pool filter sand. Top of sand at 3.2 feet below ground surface. Added 0.33 bucket of bentonite pellets. Top of dry bentonite at 2.5 feet below ground surface.	

AEHA Form 130, 1 Nov 82
Replaces HSHB Form 78, 1 Jun 80, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

(The proponent of this form is HSHB-ES)

INSTALLATION Chester Memorial USARC, Chester, Vermont
PROJECT NUMBER 38-26-KL45-93 DATE 27 April 1993
LOCATION 5.6 feet west from the west wall of main Bldg. and about 57 feet north from the southwest corner of main Bldg. GEOLOGIST David C. Bayha
DRILLER AND HELPER I. Richard Kestner and Rocky W. Hoover
DRILL RIG Mobile B-80 W/6-in. hollow-stem auger BORE HOLE Well 9 (Downgradient)

DEPTH	SAMPLE TYPE	DESCRIPTION	REMARKS
	Soil Sample 0-4' for VO & TPH	Medium brown sandy, silty, clay with some mica flakes.	Dry to moist, somewhat plastic. Easy drilling. No fuel oil odor.
4'	------	----------	----------
4.5'	------	--Same as above----------	----------
5'		Encountered gravel and boulders.	Very hard drilling. No returns.
6.4'	------	----------	----------
7.5'	------	Light greenish-gray sandy, silty clay with mica flakes----------	Easier drilling. Dry to slightly moist. Somewhat plastic.
	Soil sample	Same as above.	
9'	------	----------	----------
9.5'	------	--Same as above.----------	----------
10'		Encountered gravel and boulders.	Very hard drilling. No returns.
12'	Soil sample 12-13' for VO & TPH	---------- Fuel oil in soil.	----------
13.2'		Bottom of Hole----------	----------

AEHA Form 130, 1 Nov 82
Replaces HSHB Form 78, 1 Jun 80, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

(The proponent of this form is HSHB-ES)

INSTALLATION Chester Memorial USARC, Chester, Vermont
PROJECT NUMBER 38-26-KL45-93
LOCATION 5.6 feet west from the west wall of main Bldg. and about 57 feet north from the southwest corner of main Bldg.
DRILL RIG Mobile B-80 W/6-in. hollow-stem auger

DATE 27 April 1993
GEOLOGIST David C. Bayha
DRILLER AND HELPER I. Richard Kestner and Rocky W. Hoover
BORE HOLE Well 9 (Downgradient)

DEPTH	SAMPLE TYPE	DESCRIPTION	REMARKS
		Added 10 feet of 0.01 inch slot-sized PVC screen with well point and 5 feet of solid PVC casing. Total amount of PVC casing in hole is 15.43 feet. The top of the PVC riser pipe is 2.21 feet above ground surface. Added 2.5 50-lb bags of swimming pool filter sand. Top of sand at 2.8 feet below ground surface. Added 1 bucket of bentonite pellets. Top of dry bentonite at ground surface.	

AEHA Form 130, 1 Nov 82
Replaces HSHB Form 78, 1 Jun 80, which will be used.

APPENDIX D

GROUND-WATER SAMPLING FIELD DATA LOGSHEETS

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 1 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: _____
a. Depth to water from top of casing: 8.39 feet
b. Height of PVC casing above ground surface: 2.78 feet
c. Depth to water from ground surface: (a-b) 5.61 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (22.1 feet) - 5.61 feet) X 0.50
(total well depth) (depth to water) (CF)

= 8.2 gallons

Amount actually purged: 10.0

Well pumped/bailed dry? ___yes X no

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 6.0 °C

pH: _____

Conductivity: 0.052 mmhos/cm X 1000 = 52 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 2 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 0900
a. Depth to water from top of casing: 12.38 feet
b. Height of PVC casing above ground surface: 2.87 feet
c. Depth to water from ground surface: (a-b) 9.51 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 0955

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (24.56 feet) - 9.51 feet) X 0.50
{total well depth} {depth to water} {CF}

= 7.5 gallons

Amount actually purged: 10.0

Well pumped/bailed dry? yes X no

SAMPLING

Date: 28 APRIL 93 Time:

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 9.0 °C

pH:

Conductivity: 0.065 mmhos/cm X 1000 = 65 µmhos/cm

Dissolved Oxygen: ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 3 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 1125
a. Depth to water from top of casing: 3.56 feet
b. Height of PVC casing above ground surface: 2.79 feet
c. Depth to water from ground surface: (a-b) 0.77 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 1405

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well=0.5, 4-inch well=2.0

3-well volumes = (14.44 feet) - 0.77 feet) X 0.50
(total well depth) (depth to water) (CF)

= 6.8 gallons

Amount actually purged: 5.0

Well pumped/bailed dry? X yes ___no (DRY TWO TIMES)

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 8.0 °C

pH: _____

Conductivity: 0.082 mmhos/cm X 1000 = 82 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 4 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 1045
a. Depth to water from top of casing: 9.13 feet
b. Height of PVC casing above ground surface: 2.52 feet
c. Depth to water from ground surface: (a-b) 6.61 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 1105

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (23.9 feet) - 6.61 feet) X 0.50
{total well depth} {depth to water} {CF}

= 8.6 gallons

Amount actually purged: 10.0

Well pumped/bailed dry? ___yes X no, BUT WATER LEVEL FELL

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 5.0 °C

pH: _____

Conductivity: 0.055 mmhos/cm X 1000 = 55 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 5 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 1005
a. Depth to water from top of casing: 10.13 feet
b. Height of PVC casing above ground surface: 2.92 feet
c. Depth to water from ground surface: (a-b) 7.21 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 1025

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (24.0 feet) - 7.21 feet) X 0.50
{total well depth) {depth to water) {CF}

= 8.4 gallons

Amount actually purged: 10.0

Well pumped/bailed dry? ___yes X no

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 7.0 °C

pH: _____

Conductivity: 0.045 mmhos/cm X 1000 = 45 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 6 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 1350
a. Depth to water from top of casing: 9.10 feet
b. Height of PVC casing above ground surface: 0.38 feet
c. Depth to water from ground surface: (a-b) 8.72 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 1420

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (25.05 feet) - 8.72 feet) X 0.50
(total well depth) (depth to water) (CF)

= 8.2 gallons

Amount actually purged: 10.0

Well pumped/bailed dry? ___yes _X_no

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 11.0 °C

pH: _____

Conductivity: 0.051 mmhos/cm X 1000 = 51 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 7 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 1305
a. Depth to water from top of casing: 6.27 feet
b. Height of PVC casing above ground surface: 1.45 feet
c. Depth to water from ground surface: (a-b) 4.82 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 1510

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (21.0 feet) - 4.82 feet) X 0.50
(total well depth) (depth to water) (CF)

= 8.1 gallons

Amount actually purged: 25.0

Well pumped/bailed dry? ___yes X no

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 4.5 °C

pH: _____

Conductivity: 0.088 mmhos/cm X 1000 = 88 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 8 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: 1330
a. Depth to water from top of casing: 5.93 feet
b. Height of PVC casing above ground surface: - 0.15 feet
c. Depth to water from ground surface: (a-b) 6.08 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): TEFLON BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well=0.5, 4-inch well=2.0

3-well volumes = (14.5 feet) - 6.08 feet) X 0.50
{total well depth} {depth to water} {CF}

= 4.25 gallons

Amount actually purged: 10.0

Well pumped/bailed dry? ___yes X no

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 8.4 °C

pH: _____

Conductivity: 0.092 mmhos/cm X 1000 = 92 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

WELL ID: WELL No. 9 INSTALLATION: CHESTER ARC, CHESTER, VT

WATER LEVEL MEASUREMENTS (before developing)
Date: 28 APRIL 93 Time: _____
a. Depth to water from top of casing: 8.70 feet
b. Height of PVC casing above ground surface: 2.21 feet
c. Depth to water from ground surface: (a-b) 6.49 feet

Measuring method: electric meter

PURGING

Date: 28 APRIL 93 Time: 1330

Equipment (bailer or pump): STAINLESS STEEL BAILER

Inside diameter of well: 2 inches

Conversion factors (CF): 2-inch well = 0.5

3-well volumes = (13.22 feet) - 6.49 feet) X 0.50
(total well depth) (depth to water) (CF)

= 3.4 gallons

Amount actually purged: 2.5

Well pumped/bailed dry? X yes ___no (BAILED DRY TWICE)

SAMPLING

Date: 28 APRIL 93 Time: _____

Equipment (bailer or pump): SINGLE SAMPLE BAILER

FIELD MEASUREMENTS

Temperature: 7.0 °C

pH: _____

Conductivity: 0.121 mmhos/cm X 1000 = 121 µmhos/cm

Dissolved Oxygen: _____ ppm

COMMENTS:

APPENDIX E

GROUND-WATER MONITORING WELL SUMMARY

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
GROUND-WATER MONITORING WELL SUMMARY

INSTALLATION CHESTER USARC, CHESTER, VT PROJECT NO. 38-26-KL45-93

WELL NUMBER	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Well No. 5
1. Height of Monitoring Well Casing above ground level	2.78 Feet	2.87 Feet	2.79 Feet	2.52 Feet	2.92 Feet
2. Total Depth of Well below ground level	22.09 Feet	24.56 Feet	14.44 Feet	23.91 Feet	24.01 Feet
3. Depth to Top of Well Screen below ground level	6.66 Feet	9.13 Feet	4.01 Feet	8.48 Feet	8.58 Feet
4. Well Screen Length	15.43 Feet	15.43 Feet	10.43 Feet	15.43 Feet	15.43 Feet
5. Well Screen Slot Size	0.01 Inch	0.01 Inch	0.01 Inch	0.01 Inch	0.01 Inch
6. Well Diameter	2.0 Inches	2.0 Inches	2.0 Inches	2.0 Inches	2.0 Inches
7. Monitoring Well Casing Material	PVC	PVC	PVC	PVC	PVC
8. Monitoring Well Screen Material	PVC	PVC	PVC	PVC	PVC
9. Grout Thickness below ground level	5.7 Feet	3.3 Feet	1.65 Feet	4.0 Feet	5.5 Feet
10. Depth to Top of Bentonite Seal below ground level	5.7 Feet	3.3 Feet	1.65 feet	4.0 Feet	5.5 Feet
11. Bentonite Seal Thickness	0.3 Feet	3.2 Feet	1.55 Feet	3.2 Feet	1.8 Feet
12. Depth to top of Sand Pack	6.0 Feet	6.5 Feet	3.2 Feet	7.2 Feet	7.3 Feet
13. Depth to Static Water Level at completion	10.74 Feet	15.41 Feet	4.94 Feet	12.41 Feet	13.38 Feet
Date Measured	20 June 1992	20 June 1992	20 June 1992	20 June 1992	20 June 1992
14. Depth to Static Water Level from top of monitoring well casing	8.39 Feet	12.38 Feet	3.56 Feet	9.13 Feet	10.13 Feet
Date Measured	28 April 1993	28 April 1993	28 April 1993	28 April 1993	28 April 1993
15. Elevation - Top of monitoring well casing	51.22 Feet	50.35 Feet	49.56 Feet	47.84 Feet	48.38 Feet
16. Elevation at ground level	48.44 Feet	47.48 Feet	46.77 Feet	45.32 Feet	45.46 feet
17. Depth to Static Water from ground level	5.61 feet	9.51 Feet	0.77 Feet	6.61 Feet	7.21 Feet
Date Measured	28 April 1993	28 April 1993	28 April 1993	28 April 1993	28 April 1993
18. Ground-water elevation	42.83 Feet	37.97 Feet	46.00 Feet	38.71 Feet	38.25 feet
Date Measured	28 April 1993	28 April 1993	28 April 1993	28 April 1993	28 April 1993
Comments					

AEHA Form 93-R, 1 JUN 88 (HSHB-ME-SG) Previous editions of this form are obsolete.

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
GROUND-WATER MONITORING WELL SUMMARY

INSTALLATION CHESTER USARC, CHESTER, VT PROJECT NO. 38-26-KL45-93

WELL NUMBER	Well No. 6	Well No. 7	Well No. 8	Well No. 9	
1. Height of Monitoring Well Casing above ground level	0.38 Feet	1.45 Feet	- 0.15 Feet	2.21 Feet	
2. Total Depth of Well below ground level	25.05 Feet	21.03 Feet	14.58 Feet	13.22 Feet	
3. Depth to Top of Well Screen below ground level	9.62 Feet	5.60 Feet	4.15 Feet	2.79 Feet	
4. Well Screen Length	15.43 Feet	15.43 Feet	10.43 Feet	10.43 Feet	
5. Well Screen Slot Size	0.01 Inch	0.01 Inch	0.01 Inch	0.01 Inch	
6. Well Diameter	2.0 Inches	2.0 Inches	2.0 Inches	2.0 Inches	
7. Monitoring Well Casing Material	PVC	PVC	PVC	PVC	
8. Monitoring Well Screen Material	PVC	PVC	PVC	PVC	
9. Grout Thickness below ground level	4.1 Feet	0.9 Feet	2.5 Feet	0.0 Feet	
10. Depth to Top of Bentonite Seal below ground level	4.1 Feet	0.9 Feet	2.5 Feet	0.0 Feet	
11. Bentonite Seal Thickness	3.0 Feet	1.7 Feet	0.7 Feet	2.8 Feet	
12. Depth to top of Sand Pack	7.1 Feet	2.6 Feet	3.2 Feet	2.8 Feet	
13. Depth to Static Water Level at completion	10.10 Feet	6.27 Feet	5.93 Feet	8.70 Feet	
Date Measured	20 June 1992	28 April 1993	28 April 1993	28 April 1993	
14. Depth to Static Water Level from top of monitoring well casing	9.10 Feet	6.27 Feet	5.93 Feet	8.70 Feet	
Date Measured	28 April 1993	28 April 1993	28 April 1993	28 April 1993	
15. Elevation - Top of monitoring well casing	49.52 Feet	46.09 Feet	46.62 Feet	51.34 Feet	
16. Elevation at ground level	49.14 Feet	44.64 Feet	46.77 Feet	49.13 Feet	
17. Depth to Static Water from ground level	8.72 feet	4.82 Feet	6.08 Feet	6.49 Feet	
Date Measured	28 April 1993	28 April 1993	28 April 1993	28 April 1993	
18. Ground-water elevation	40.42 Feet	39.82 Feet	40.69 Feet	42.64 Feet	
Date Measured	28 April 1993	28 April 1993	28 April 1993	28 April 1993	
Comments					

AEHA Form 93-R, 1 JUN 88 (HSHB-ME-SG) Previous editions of this form are obsolete.

APPENDIX F

ORGANIC COMPOUNDS ANALYZED AND THEIR RESPECTIVE DETECTION LIMITS

Installation: Chester USARC
Matrix: Ground Water
Number of Samples: 9 and a Field Blank
Analyzed for: Volatile Organic Compounds (Method: 8260) and Semivolatile Organic Compounds (Method: 8270)

Matrix: Soil
Number of Samples: 6
Analyzed for: Volatile Organic Compounds
Method: 8260 Heating Purge

Matrix: Soil
Number of Samples: 8
Analyzed for: Total Petroleum Hydrocarbon Content
Detection limit for water is one milligrams per liter (1.0 mg/L) and for soil is 10 micrograms per gram (10 μg/g)

Purgeable (Volatile) Organic Compounds: Detection Limit for water is in micrograms per liter (μg/L) and for soil in micrograms per kilogram (μg/Kg)

	Water in μg/L	Soil in μg/Kg
Benzene	2.0	5.0
Bromobenzene	2.0	5.0
Bromochloromethane	2.0	5.0
Bromodichloromethane	2.0	5.0
Bromoform	2.0	5.0
Bromomethane	2.0	5.0
n-Butylbenzene	2.0	5.0
sec-butylbenzene	2.0	5.0
tert-butylbenzene	2.0	5.0
Carbon tetrachloride	2.0	5.0
Chlorobenzene	2.0	5.0

Geohydrologic Study No. 38-26-KL45-93, 26-29 Apr 93

	Water in µg/L	Soil in µg/Kg
Chloroethane	2.0	5.0
Chloroform	2.0	5.0
Chloromethane	2.0	5.0
2-Chlorotoluene	2.0	5.0
4-Chlorotoluene	2.0	5.0
Dibromochloromethane	2.0	5.0
1,2-Dibromo-3-chloropropane	2.0	5.0
1,2-Dibromoethane	2.0	5.0
Dibromomethane	2.0	5.0
1,2-Dichlorobenzene	2.0	5.0
1,3-Dichlorobenzene	2.0	5.0
1,4-Dichlorobenzene	2.0	5.0
Dichlorodifluromethane	2.0	5.0
1,1-Dichloroethane	2.0	5.0
1,2-Dichloroethane	2.0	5.0
1,1-Dichloroethene	2.0	5.0
cis-1,2-Dichloroethene	2.0	5.0
trans-1,2-Dichloroethene	2.0	5.0
1,2-Dichloropropane	2.0	5.0
1,3-Dichloropropane	2.0	5.0
2,2-Dichloropropane	2.0	5.0
1,1-Dichloropropene	2.0	5.0
cis-1,3-Dichloropropene	2.0	5.0
trans-1,3-Dichloropropene	2.0	5.0
Ethylbenzene	2.0	5.0
Hexachlorobutadiene	2.0	5.0
Isopropylbenzene	2.0	5.0
p-Isopropyltoluene	2.0	5.0
Methylene chloride	2.0	5.0
Naphthalene	2.0	5.0
n-Propylbenzene	2.0	5.0
Styrene	2.0	5.0
1,1,1,2-Tetrachloroethane	2.0	5.0
1,1,2,2-Tetrachloroethane	2.0	5.0
Tetrachloroethene	2.0	5.0
Toluene	2.0	5.0
1,2,3-Trichlorobenzene	2.0	5.0
1,2,4-Trichlorobenzene	2.0	5.0

	Water in µg/L	Soil in µg/Kg
1,1,1-Trichloroethane	2.0	5.0
1,1,2-Trichloroethane	2.0	5.0
Trichloroethene	2.0	5.0
Trichlorofluromethane	2.0	5.0
1,2,3-Trichloropropane	2.0	5.0
1,2,4-Trimethylbenzene	2.0	5.0
1,3,5-Trimethylbenzene	2.0	5.0
Vinyl chloride	2.0	5.0
o-Xylene	2.0	5.0
m & p-Xylene	2.0	5.0

Semivolatile (Acid and Base/Neutral) Organic Compounds: Detection Limit for water is in micrograms per liter (µg/L)

Acid Extractable Organics	µg/L
phenol	10.0
2-chlorophenol	10.0
2-methylphenol	10.0
4-methylphenol	10.0
2-nitrophenol	10.0
2,4-dimethylphenol	10.0
2,4-dichlorophenol	10.0
4-chloro-3-methylphenol	10.0
2,4,6-trichlorophenol	10.0
2,4,5-trichlorophenol	50.0
2,4-dinitrophenol	50.0
4-nitrophenol	50.0
4,6-dinitro-2-methylphenol	50.0
pentachlorophenol	50.0

Base Neutral Extractable Organics	Detection Limit in micrograms per liter (µg/L)
bis (2-chloroethyl) ether	10.0
1,3-dichlorobenzene	10.0
1,4-dichlorobenzene	10.0
1,2-dichlorobenzene	10.0
bis (2-chloroisopropyl) ether	10.0
N-nitrosodi-n-propylamine	10.0
hexachloroethane	10.0
nitrobenzene	10.0
isophorone	10.0
bis (2-chloroethoxy) methane	10.0
1;2,4-trichlorobenzene	10.0
naphthalene	10.0
4-chloroaniline	10.0
hexachlorobutadiene	10.0
2-methylnaphthalene	10.0
2-chloronaphthalene	10.0
hexachlorocyclopentadiene	10.0

Geohydrologic Study No. 38-26-KL45-93, 26-29 Apr 93

Base Neutral Extractable Organics	Detection Limit in micrograms per liter (μg/L)
2-nitroaniline	50.0
3-nitroaniline	50.0
4-nitroaniline	50.0
dimethyl phthalate	10.0
acenaphthylene	10.0
2,6-dinitrotoluene	10.0
acenaphthene	10.0
dibenzofuran	10.0
2,4-dinitotoluene	10.0
diethyl phthalate	10.0
4-chlorophenyl phenyl ether	10.0
fluorene	10.0
N-nitrosodiphenylamine	10.0
4-bromophenyl phenyl ether	10.0
hexachlorobenzene	10.0
phenanthrene	10.0
anthracene	10.0
di-n-butyl phthalate	10.0
fluoranthene	10.0
pyrene	10.0
butyl benzyl phthalate	10.0
3,3'-dichlorobenzidine	20.0
benzo (a) anthracene	10.0
chrysene	10.0
bis (2-ethylhexyl phthalate	10.0
di-n-octyl phthalate	10.0
benzo (b) fluoranthene	10.0
benzo (k) fluoranthene	10.0
benzo (a) pyrene	10.0
indeno (1,2,3-cd) pyrene	10.0
dibenz (a,h) anthracene	10.0
benzo (ghi) perylene	10.0
benzyl alcohol	20.0
benzoic acid	50.0

APPENDIX G

TECHNICAL ASSISTANCE

1. Requests for services should be directed through appropriate command channels of the requesting activity to Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-ME-SG, Aberdeen Proving Ground, MD 21010-5422, with an information copy furnished the Commander, U.S. Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

2. The numbered programs, and the program managers and their telephone numbers [DSN 584-XXXX or Commercial (410) 671-XXXX] are listed below for general support.

Program Number	Program Title	Program Manager	Telephone Number
11	Occupational Medicine Residency	LTC Deeter	4312
16	Pest Management	Mr. Wells	3613
17	Pesticide Risk Management	Dr. Evans	4131
24	Radio Frequency Radiation/Ultrasound	Mr. Hicks	4834
25	Laser/Optical Radiation	Dr. Sliney	3932
27	Industrial Health Physics	Mr. Edge	3526
28	Medical Health Physics	CPT Bower	3548
31	Water Supply Management	MAJ Rudolph	3919
32	Wastewater Management	Mr. Fifty	3816
37	Hazardous and Medical Waste	Mr. Resta	3651
38	Ground Water and Solid Waste	Mr. Bauer	2025
39	Health Risk Assessment	MAJ Legg	2953
42	Air Pollution Source Management	Mr. Daughdrill	3500
43	Ambient Air Quality Management	Mr. Guinivan	3500
51	Hearing Conservation	Dr. Ohlin	3797
52	Environmental Noise	Dr. Luz	3829
54	Special Industrial Hygiene Services	Ms. Doganiero	3928
55	Industrial Hygiene	MAJ Sheaffer	2559
56	Healthcare Hazards	CPT McKee	3040
57	Sanitation and Hygiene	MAJ McDevitt	2488
59	Industrial Hygiene Management	Ms. Monk	2439
63	Vision Conservation	LTC Thompson	2714
64	Occupational and Environmental Medicine	MAJ Gum	2714
65	Occupational Health Nursing	Dr. Dash	2714
66	Special Document Development	Ms. Kestler	3254
69	Health Hazard Assessment	LTC Murnyak	2925
74	Analytical Quality Assurance	CPT Lukey	3269
75	Toxicology Assessment	Mr. Weeks	3627
76	Organic Environmental Chemistry	Mr. Belkin	3739
78	Radiological/Inorganic Chemistry	Dr. Boldt	2619

3. Direct support is provided by:

USAEHA Activity - North, Fort George G. Meade, MD	LTC Phull, DSN 923-7403
USAEHA Activity - South, Fort McPherson, GA	LTC Broadwater, DSN 572-3332
USAEHA Activity - West, Fitzsimons AMC, CO	LTC Aiken, DSN 943-3737